OBJECT LESSONS:

A PAPER READ AT THE CONVENTION OF PROTESTANT TEACHERS OF THE PROVINCE OF QUEBEC.

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The question that meets us at the outset of our enquiry into the nature of the Object Lesson is this:—What is its purpose? The Object Lesson is one of the manifestations of that vastly increased interest in popular education, which is so characteristic of the present century. What want, instinctively recognized or openly expressed, was it intended to meet? In what respects did the instruction furnished in schools fail to meet the demand for knowledge of an important kind, or to educate faculties of which the full control was needful for success in life? And how was the Object Lesson expected to supplement the work of schools? To answer these questions we must consider the character of the schools in which the Object Lesson was introduced in its present form, and what instruction and education they really gave.

So far as I am aware, Object Lessons, wherever originated or introduced, have been specially used in schools of primary grade, and more especially in those of low social character. In the attempt, by popular instruction, to lift to a higher level of culture the sunken classes of the Old World, the ill-fed and boorish children of the peasantry, the neglected offspring of the crowded and squalid populations of manufacturing centres, it was soon found—remember that I am speaking generally and that individual exceptions are very numerous—that amid such unfavorable surroundings the stock of general information of the pupils was limited, the number of things with which they were familiar few, their knowledge of the mother-tongue very inadequate, and, consequently, their mental faculties were, on the whole, obtuse and sluggish, even though in some directions precociously developed by hardship. At first, indeed, it was hoped that these difficulties would disappear as school instruction advanced; but no very wide experience was necessary to show that some of them lay at the very threshold of learning, so that they had to be encountered before school instruction could properly begin, and that others were of such a character that school discipline could not meet them effectually. For, in the first place, all school arrangements suppose a certain amount of precedent cultivation, considerable familiarity with the mother-tongue and some facility in its use, a stock of common ideas, and an habituation to the use of the various mental faculties. All these the child of intelligent parentage has, and this to so great an extent that the stock of knowledge of such a child of six years of age bears no insignificant ratio to that which he will acquire in addition during his school career. But, when a child appears in school whose only companions have been the degraded, whose only incentives to action have been hunger, thirst and blows, whose vocabulary is limited to the expression of his animal wants and gratifications, it is scarcely to be conceived, without experience, how inert and sluggish will be the mental power, how

meagre the mental furniture, and how disappointing in its results the efforts at instruction. It was evident, further, that the ordinary school instruction could not remedy such a state of ignorance and mental torpor. Reading, writing, spelling, arithmetic, became mere mechanical exercises, learned, so far as they could be learned at all, by rote, and affording little or no mental enlightment or discipline. The experience of painstaking and conscientious teachers soon showed that nothing but converse—oral converse—between the pupil and the teacher could arouse the inactive mind to healthful and fruitful exertion. Such conversational lessons were the seed from which Object Lessons in their highest development sprang. Pestalozzi used them chiefly as a means of cultivating language, so that his pupils might become familiar with the meaning and the use of words in regions of thought that lay a little beyond their daily experiences. Disciples of that ingenious and brilliant though erratic and visionary teacher enlarged his conception of the Object Lesson by making it subserve the purpose of more or less systematic instruction in useful knowledge, and with more or less definiteness and consciousness of purpose used it as a means of developing the powers of thought.*

To the empirical slowly succeeds the scientific stage of education. In orderly array the varied activities, physical, mental and moral of a child have passed in review before the increasing body of scientific educators. Attempts, more or less successful, but in any case still imperfect, have been made to determine the sequence and mode of development of the mental powers. The various branches of school study and the prevalent modes of instruction have been examined with a view to determine—not merely with what intellectual equipment the school boy steps out into active life—but what faculties have been exercised and strengthened in acquiring that intellectual equipment, and what, if any, remain undeveloped or even by disuse have become atrophied. The result of such enquiries has been to bring into view the necessary imperfection of the ordinary school curriculum as an instrument of mental culture—to demonstrate the value as an introduction to successful life, not only of the moral qualities, but also of the mental habitudes cultivated at home in intercourse with friends, and in the play-ground in collision with playmates—and to evoke the question: Can nothing be advantageously done to systematize and to pursue of set design the cultivation of the intellect, where hitherto it has been left to the desultory and undesigned influences of out-of-school life? Let us, for our present purpose, adopt as an enumeration of the faculties of the intellect, consciousness, sense, reason, judgment, abstraction, imagination, understanding, memory; and, to avoid confusion, define these to be consciousness, the faculty that gives us subjective phenomena; sense, that which gives us objective phenomena; reason, that which gives the logical antecedents of phenomena; judgment, the faculty which compares phenomena and gives differences, resemblances and relations; abstraction, that which analysing phenomena gives abstract notions and so classifies and generalizes; imagination, the faculty which re-unites abstractions and so creates, invents and plans; understanding, the faculty which uses and comprehends signs of ideas, and so, by language in all its varied forms, receives and communicates thought; and memory as the faculty which recalls mental impressions of every kind.

* Consult Krusi's "Pestalozzi, his Life, Work and Influence," an excellent work that should be read by every teacher.

With this enumeration before us it must be evident to all who have the necessary experience of school life and duty, that but few of these faculties are directly and designedly cultivated, that some only of those that remain are incidentally trained, and that, even where the training is most explicit and thorough, it is very far from developing the faculties affected in all directions. In other words, the allegation is that some faculties are not trained at all, some only by accident, and none of them completely and harmoniously. Of the intuitive faculties neither consciousness nor reason is trained at all, and any training of sense is accidental, indefinite, uncertain, and most imperfect. The training of consciousness and reason are deferred, some think necessarily, to a period subsequent to school-days; that of sense which cannot be postponed is relegated in the main to the playground, the street and the fireside. The eye is indeed trained to the discrimination and recognition of forms in reading, writing, spelling, map-geography and geometry; the ear to observe musical sounds and the intonations of speech; the rest of the senses receive no attention in school. Judgment receives but little training. Imagination is somewhat developed through the understanding in various school exercises, but is not trained to independent action except in composition, and in inventing solutions of arithmetical, algebraic, and geometric problems. The development of memory is very disproportionate; it is loaded with verbal statements and with numerical combinations, some aptitude for remembering forms s acquired, in other respects it is neglected. The school curriculum, then, has left each sense to be trained in most or in all of its uses; the powers of consciousness and reason to be subjected to the control of the will; judgment, abstraction and imagination in most of their applications to be disciplined; and the memory to be developed along with the developing faculties. It may not be desirable during childhood to attempt to arouse consciousness to voluntary action in the act of reflection, and the sphere of activity of reason is but limited in early life, but the remaining faculties are more or less vigorous. How can they most advantageously be drilled to orderly and effective service? I think, that the full answer to this question has never been given; that, indeed the full answer could not now be received if any man were wise enough to give it. Yet educators have furnished two answers, which, though but partial, are practical. The first is that Object Lessons effectually train some powers neglected in ordinary school work. The second is that the methods of the Kindergarten do so.

The purpose then of the Object Lesson, as by the light of psychology we now begin to regard it, is mainly the development of the intellectual faculties of childhood, more especially of those which are comparatively neglected in the ordinary school curriculum. It does not indeed neglect the older purposes of training in the use of language and of imparting useful knowledge, but these purposes should be, and in the best use of the Object Lesson are, made subsidiary to this main purpose, the educational discipline and training of the ntellect. As the secret of all educational discipline is the frequent repietition, under direction, of mental acts, the successful conduct of an Object Lesson will place the teacher in his true position of guide, critic and correcttor. The mental exercises must be performed by the pupils themselves, not by the teacher. The knowledge acquired must be discovered by the learners, not revealed to them. But knowledge not received on tesimony is either intuitive or derived by inference. Intuitive knowledge can only be attained in the actual presence of the object of thought,

and even the process of inferring knowledge is frequently much facilitated by its presence; hence the need for submitting an object to the learner's investigation. An exhaustive view of any object can seldom be obtained except by adding to the results of our own observation, experiment and thought, the results of the observation, experiment and thought of others. Hence some information respecting the object under examination may be collected from books or be received from the teacher, but this should be as small in amount as possible. In the course of an Object Lesson, to allow the knowledge of the pupils to be imperfect is often preferable to supplementing that knowledge by testimony. Knowledge reached by the pupil is almost necessarily fragmentary, disjointed, ill-arranged. It becomes science only when by subsequent effort it is reduced to an orderly system, in which the parts are duly correlated. This systematizing of the results of investigation is one of the most important parts of an Object Lesson.

We are now, perhaps, in a position to define the Object Lesson. This is the definition which I venture to submit. An Object Lesson is an exercise in which, under the guidance of a teacher, pupils, expressing themselves in appropriate language, 1st, review the knowledge they already possess respecting an object or a topic; 2nd, add to that knowledge primarily by the use of their own faculties, secondarily, by receiving additional information from the teacher or from books; and 3rd, systematize the whole.

With this view of the Object Lesson, there will be no danger of supposing it to be a mere word lesson, or a lecture by the teacher conveying more or less entertaining information. Such views are imperfect, not erroneous. The definition proposed above implies the value of the Object Lesson as an exercise in the use of language. All true teachers feel it to be of the utmost importance to secure for their pupils as much practice in oral composition as is possible. Hence the endeavor to get pupils to give in their own words their impressions of lessons. The great difficulties with this exercise are,' 1st, that pupils often only give as much as they can remember of the language of the text-book or of the teacher; 2nd, that barrenness and confusion of statement result as often from the incompleteness and incongruity of their conceptions as from the poverty of their vocabulary and their want of mastery of syntactical forms. It is therefore of great value to secure an exercise in which children must endeavor to put into language, that is not a mere imperfect echo of the utterances of their teacher, their impressions of an object of which, being present, their conceptions cannot be incongruous, and, being under examination, cannot remain very remarkably incomplete. It adds also very much to the clearness and vividness of the ideas which words suggest to have them associated directly with the intuitions of sense by using them in the description of present objects. On this account it is that Object Lessons are particularly valuable in teaching the conversational use of a language. Indeed, it is by a desultory sort of Object Lesson that a child learns to use so soon and so skilfully its mother tongue. While then I caution teachers against making the Object Lesson a *mere* word lesson, and advise the observance of a wise reticence on their part, let me not be understood to imply that the teacher must never give utterance to the thought of children. It is often his duty and his opportunity to do this, but his more matured, accurate and appropriate expression must succeed not precede their attempted utterances. He must give no new word, recall no forgotten word, until its want is felt, either for brevity, or for exactness, or for force. The review of knowledge already pos-

sessed is valuable as an exercise of the memory and of the understanding in recalling and expressing a conception. But it is also of service in informing the teacher of the state of knowledge of the pupils, so that he may not tediously dwell upon what is already clearly conceived, nor fruitlessly aim at what is beyond present attainment, nor assume as known what is not understood. It will be observed, and perhaps it will be objected, that I have introduced into the definition the word "topic" as alternative to the word "object." To those who on the ground of the title, Object Lessons, demur to class under this title lessons on topics, I plead in excuse that such an extension of the meaning of terms as this classing implies is not unwarranted by example, as I am by no means the first who has been compelled to employ the term Object Lesson in a sense wider than is justified by its derivation, for lack of a pre-existing term or phrase of sufficient comprehensiveness. I would further plead that the boundary between Lessons on Objects and Lessons on Topics will be found by no means well defined in actual practice, and that many lessons on topics, except in regard to sense intuitions, require the same treatment and cultivate the same faculties as Object Lessons. Omitting for the moment remark on what constitutes the very essence of the Object Lesson, viz., the acquisition of knowledge by the use of children's own faculties, let us observe that in the impartation of knowledge by the teacher orally this advantage over its impartation by books is secured, that the pupil is practised in observing carefully and remembering accurately what is said—a preparation for business and for public life which cannot be overvalued. But as oral instruction should be, and is, given in other subjects, the Object Lesson has in this particular no superiority to them; and but for the need of occasionally filling in gaps in the systematic scheme of an Object Lesson that cannot be filled by the observation, experience or experiment of children, and but for the quickening of interest that results from the presentation of the novel and the strange to youthful minds, it would, as a matter of mental discipline simply considered, be better for the teacher to give no information at all. However, the Object Lesson will never cease to be to some extent an information lesson, and the sole caution to the teacher must be to avoid giving any information that by their own powers of observation, conjoined with inductive and deductive inference, pupils can of themselves attain. Of course nothing here said will be considered adverse to such directive suggestion as the teacher may make in reference to the subject of investigation. As the last of these brief comments on the definition, I must say that the systematizing of the whole mentioned in it refers rather to the minor arrangement of the items of information than to the general scheme of the Object Lesson, which must usually be provided by the teacher before the lesson commences, and which may be common to many different Object Lessons, since the most natural, and to beginners obvious arrangement, is one dependent on the use, in a definite and systematic manner, of the several faculties employed in the investigation of truth.

Permit me now to submit a scheme for the management of an Object Lesson, which, though not at first set before children, may be present in the teacher's mind as a type of method to which he may by suggestion and restraint advantageously induce the discursive mind of childhood to conform, and which may be afterwards formally introduced section after section, as the acknowledged guide of investigation, until the matured powers of the pupils and the peculiarity of the object

investigated combine to render some other scheme preferable. I propose five general heads :—

1. Parts and materials—Separation. Analysis.
2. Qualities—Ascertained by observation.
3. Susceptibilities—Ascertained by experiment.
4. Relations—Ascertained by reason, judgment, abstraction.
5. Associations—Suggested by imagination.

In conformity with this arrangement the preliminary review as well as the subsequent lesson should be conducted. It would be advisable to have a definite course of Object Lessons corresponding to the mental capacity of children of the several school grades. This course should rise from the lower to the higher grades along a line determined not so much by the subjects chosen as by the mode of treatment. The same subject might recur again and again in the course, being treated with more minuteness, fulness and profundity as the powers of pupils develop. Iron, for example, might be the subject of a profitable Object Lesson with children five or six years of age, or of interesting and instructive discussion at a session of a scientific congress. The mode of treatment in the two cases would certainly be different, but not dissimilar.

The scheme given above is one that easily lends itself to the difference of treatment rendered necessary by different stages of culture. At first it would be well to direct attention to the second and third heads of the scheme in connection with simple substances, discovering by observation and experiment their qualities and susceptibilities. A useful sub-division of the head Qualities might be founded on the senses by which qualities are discovered, still further subdivided into the qualities given by each sense. The sub-scheme to Qualities would then be something like this :—

2. QUALITIES.

a. Sight—Color.
b. Touch—Temperature. } Distance, Motion.
c. Muscular Sense—Weight. } Solids, Liquids, Gases, Shape, Size,
d. Hearing—Pitch, Intensity, Quality of sounds.
e. Taste—Sour, Sweet, Bitter, and their combinations.
f. Smell—Odors (scarcely susceptible of classification).

The study of numerous objects, covertly conducted by the above scheme, should familiarize the pupils with the several conceptions (and their names) embraced under it. A series of lessons on most of the qualities enumerated above should follow, and should issue in the ability to recognize, to classify, and to name the several primary, secondary and tertiary colors ; lineal, superficial, and solid forms ; the inch, foot, yard, as measures of size ; the furlong, quarter-mile, half-mile, mile, as distances ; uniform, accelerated, retarded, irregular, rectilineal, circular, curvilinear motions of translation, and rotary motion ; the ounce, the pound ; different temperatures by momentary touch, and the different conducting powers of bodies by their apparent temperatures when tried by prolonged touch. Afterward, many objects should be examined carefully with the scheme and its sub-divisions before the pupils, as a guide to systematic and minute observation. As the next step in the discipline of the observing powers, let objects be subjected to examination for brief periods only, and then withdrawn, and let the endeavor be made to register as many facts as possible about them. Pictures, in series of increasing complexity, are very suitable

objects for this exercise, so far as the eye is concerned. The exercise just suggested leads the way to the most difficult, yet in many respects most valuable, exercise of the observing faculties; that, viz., of remarking the varying appearances of bodies undergoing change, and of committing to memory in due order and comprehensiveness their successive phenomena. While observing nature these must often be seized in their flight. Successive forms, swiftly evanescent, make no sufficiently deep and abiding impression on the undisciplined observer. As a teacher of elementary science, I have had frequent opportunity to remark and to wonder at the confusion of mind of tyros who attempt to give minutely and in orderly series the processes and the results of a simple chemical experiment, even when, under direction, it has been performed by themselves. In the first steps of training to observe change, it is desirable for the teacher to predict minutely the changes that will occur. At a subsequent part of the course, it will be well to indicate generally the points to which attention should be directed. Finally, pupils must be practised in observing unexpected changes.

The third head—Susceptibilities—will afford many opportunities for practice in the observation of change. Susceptibilities include the ways in which a substance is affected by various other substances and agencies, and are determined by trial, by experiment. In a course of Object Lessons only the chief and most common of these substances and agencies need be considered, viz., mechanical force, water, heat and cold. By these the third head may be thus subdivided:

3. SUSCEPTIBILITIES.

a. Mechanical Force.—Hard or soft—tough, flexible, ductile, malleable, brittle, fissile, friable—compressible, elastic.

b. Water.—Can it be wetted? is it absorbent? does it dissolve? does it color water? will it float or sink? is it acted on in any other way?

c. Heat and Cold.—Will it expand? melt? boil? burn? explode? congeal?

Following the same general course of procedure as recommended under the head Qualities, it will be well, having familiarized the pupils with the several susceptibilities given above by a series of miscellaneous lessons, to give a series of special lessons on each, and afterwards to examine every new substance submitted according to the systematic scheme above proposed.

In bringing the sensible qualities and properties of bodies under the notice of pupils, it will be well to remember that attention to these is aroused at first by difference of sensations, especially when these are strongly contrasted, as sound renders succeeding silence more impressive. By judicious appeal to this principle the teacher will arrest attention powerfully, and so fix in the memory securely.

When, by the examination of simple objects, some familiarity with the notions classified in the scheme so far set forth has been attained, objects more or less complex may be examined, and the use of heads 2 and 3 must be preceded by the first—Parts and Material. Here will the powers of analysis be consciously exercised, and the powers of description taxed. Children must be instructed and practised in proximate, intermediate and ultimate analysis. The more obvious canons of subdivision must be stated and illustrated, and then practised by the children themselves in the division of complex objects presented to their examination. These they must be taught to divide comprehensively, exhaustively, exclusively, and in due subordination; that is, to

divide into the smallest number of parts founded upon real differences, that are entirely separate from each other, and that together make up the whole, giving them prominence in the order of importance; similarly to subdivide each part, and so to continue until further subdivision is impossible or unnecessary. They must further learn to bear in mind without confusion amid details, the scheme of subdivision, so that they can reproduce it complete and in order at will. This much neglected discipline conduces remarkably to acquiring the power of orderly, clear, continuous and exhaustive thought, and is of incalculable value in subsequent study.

At this stage may commence attempts at description. After an orderly enumeration of parts has been made, and each part has been examined as to Qualities and Susceptibilities, an essay to set the whole before the understanding in words as it has been presented in the examination should be made. The difficulty here is in presenting clearly and concisely what the *eye* has observed of size, motion, color, and yet more especially of form. He that has learned to present to the understanding a clear conception of an intricate form, will find but little difficulty with the much less complex conceptions that remain to be expressed by language. Clear and complete description depends on comprehensive, exhaustive, exclusive, and duly subordinated subdivision, so that the former may and should proceed *pari passu* with the latter. In description, let a few, bold, accurate touches outline, as in a painter's sketch, the main features; then, proceeding from the greater to the less, fill in the picture, only giving pre-Raphaelitish detail in exceptional cases. A most valuable test of the accuracy and fulness of a description, unfortunately applicable only in a few instances, is the attempt to reproduce it in a picture. Dictation exercises in drawing, inverted as it were, will strongly arouse a class, and deeply interest it in careful, precise and adequate description. Let the teacher, chalk in hand, draw on the blackboard what his pupils say in the attempt to describe some simple form, as one of the Roman Capitals, or even one of the algebraic signs, and he will evoke an amount of enthusiastic interest and of ingenious use of language that will surprise him as much as it has often surprised me. A dictation exercise in drawing is of great value as a test of the comprehension of language, but the inversion of it, in which the pupil dictates and the teacher draws, is still more valuable as a test of analytic power, and of the ability to use language for purposes of description. The number of persons who can describe with accuracy is limited. Even in this assembly of teachers I venture the assertion that there is more than one person who would fail in his first attempt to dictate one of the Roman Capitals, say even H. The test just indicated is, of course, applicable only in simple cases. But a somewhat similar test of accuracy and fulness of description is applicable even in complex instances. We may always mentally reproduce a description, and children should be encouraged to do so with their own descriptions and with those met with in books. So they will detect incongruities and deficiencies in description by the obvious impossibilities and hiatuses of the mental pictures. With such a training it would have been impossible for the immortal Irish orator to have said: "I smell a rat; I see it in the air; but, mark me, I will nip it in the bud." With such a training it would have been impossible for Professor Bain to commit in his "Education as a Science," a hundred solecisms such as this on pages 214 and 215. "A piece of information, a moral "lesson, can be wrapped up in a short tale, and brought home with "impetus. As there is a considerable expenditure of mind in propor- "tion to the result, the information or moral should be well selected;

"every little point in the vast area of useful knowledge cannot afford "the requisite machinery."

When in the awakening mind reason, judgment and the synthetic faculty are apparent, we may introduce the fourth, which is also in many respects the most important head of our scheme—Relations. The most important because of the importance of the faculties drilled, and because the ordinary school course has so little bearing on them in many of their modes of exercise. Everything has relations to things antecedent, to things contemporaneous, and to things consequent. If the object examined be artificial, the things antecedent to it, which have important relations to it, will be the design from which it sprung, and the mode of manufacture by which the design was embodied in the article. The design originated in a feeling of want that should be analyzed, and was doubtless progressively improved in a mode of development that should be traced. The process of manufacture is often both interesting and complex, one that under the guidance of the teacher may often be deduced, and should, when possible, be so deduced rather than detailed by the teacher. If the object examined be natural, the history of its genesis and development and their necessary conditions, so far as these are within the observation of pupils, should be traced. Thus will causes of things be revealed. The relations of the object to things contemporaneous are manifold ; but those of greatest importance will group themselves under the heads of Uses, Classification and Substance—Uses, embracing a consideration of the qualities and susceptibilities of the parts and of the whole, in relation to the purpose and the requirements of the whole—Classification, embracing the right setting of the object in its place, as a part of the totality of things—Substance, embracing a just conception of the relation of the phenomenal to the real, of what is to what appears. The relations of the object to things consequent will be in the main two—the first the effects on other things, the second the effects of other things upon it, in other words, its possible future modification and development.

The sub-division of the heading Relations, beginning with the present, which is the nearest and most readily apprehended, may be :

a. Classification—Relation to similar things.
b. Uses—Parts, qualities, and susceptibilities in relation to each other, and to the purpose and requirements of the whole.
c. Substance—What is, inferred from what appears.
d. Causes—If artificial, development of the design and manufacture of the article, if natural, history of its development.
e. Effects and future development.

These sub-headings are not all equally applicable to every Object Lesson. Those to which attention should first be directed, and which are indeed all but universally applicable, are Classification and Uses. In Classification the pupil is taught to ascend from particular to general conceptions, the mode of mental procedure being almost the converse of that by which a complex object is divided into its parts. The first step in the classification must be as little comprehensive as possible, must, in other words, embrace the smallest number of individuals to which we can give a general name ; or, still in other words, the individuals of the class first formed must coincide in as many points as possible, their divergencies must be as few and as unimportant as possible. Before ascending another step in the classification, the points of agree-

ment in the individuals of the class just formed should be carefully enumerated, and actual or permissible differences also indicated. Let the next superior class be then similarly formed, and so upward until the most comprehensive class is attained. The meaning of the term Uses must not be unduly restricted. In many cases the object may serve no purpose of man, yet its parts may have a subservience to the whole, to trace which will prove a most valuable discipline of imagination and judgment. So the most insignificant and worthless of living things has organs and functions subordinated to the whole, and having intricate and interesting relations to it, and to each other.

Later in the course, relations of Cause and Effect may be introduced. These relations are, of course, most readily traced and understood with things artificial, and the study of artificial things from this point of view is a necessary preliminary to the study of causes and effects among natural phenomena. As before indicated, the history of the production of any artificial thing is two-fold. The first part is the history of the design, the second is the statement of the mode of manufacture. Neither is of much value as a means of education when detailed by the teacher. Both are of the highest educational importance when rightly presented. The want or inconvenience that led to the first primitive device should be carefully analyzed in its relation to the invention. The rude original contrivance, commended to adoption by its simplicity and accessibility, should be re-invented by pupils. Its imperfections and inconvenience should be pointed out by themselves, or, in the last resort, by the teacher. Improvements should he suggested, and adaptations to various conditions of requirement should be indicated, until from its primary rude condition, through its various stages of development, the completed design with all the modifications that fit it for varying uses has been traced by the exercise of the intellects of pupils themselves, aided only by occasional suggestion from the teacher. Then will pupils be prepared to follow with lively interest any details of the actual historical development that the teacher may be prepared to give. So too, the teacher's statement of how an article is made should be preceded by an effort of invention by the pupils; they should show how they would proceed to make the article. The difficulties that they would encounter in their mode of manufacture should be pointed out, one pupil criticizing the method of another. The young inventors should devise means of surmounting the suggested difficulties, until the problem being distinctly before them, partially solved by their own endeavor, they could intelligently and with interest follow the solutions given in the practice of men.

The remaining particular under the head Relation—Substance—is one that will but seldom present itself in school work, though practice in discriminating between apparition and reality, and in deducing from phenomena the underlying substance that they both cover and reveal, is a most desirable preparation for life, in which men who occupy important positions are necessarily constantly employed in attempting to discover hidden motives concealed by professions and laid bare only in issues. Its use must always be preceded by an exhaustive examination of the phenomena, so that all that appears shall be submitted. Then reason, judgment, imagination must conjointly give an explanation or explanations that shall account for all the phenomena. When these powers give alternative explanations, the phenomena must be re-

examined, in the hope of discovering unobserved some phenomenon that may afford means of discrimination.

The last general head proposed is Associations. Here the method of treatment will vary so much with the subject and with the idiosyncrasies of temperament of teacher and pupils, that I shall not attempt to furnish a category of sub-divisions. Let each teacher deal as he pleases with any object in its aspects of grandeur or beauty, of pathos or fun. To see in any object "the light that never was on sea or land" is the heritage of those who possess, as I do not, "the poets' eye in a fine frenzy rolling."

It is obvious that no one object will require treatment in all the particulars enumerated in the foregoing scheme. To some subjects one, to others another mode of treatment is most appropriate. Accordingly, in illustrating by a few brief, imperfect, but I hope suggestive, notes portions of the foregoing scheme, I shall not take one, but three objects, choosing as illustrative of discipline in Observation, "The Weather," of the examination of Uses, "A Pair of Scissors," and of training in Invention, a lesson on an "Ink Bottle."*

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I have found it an excellent exercise to take an occasional lesson in invention pure and simple, commencing under the head Parts, by an analysis of the want and by a statement of the obviously requisite parts of the invention; proceeding next to the Materials to be used in the several parts, after consideration of the Properties essential to the materials in relation to the purposes to be subserved; and, finally, under the head of Qualities, determining the size and shape of the several parts. The method of procedure is, after suggesting any material, or proposing any form, to criticize it as severely as possible, and to devise means of obviating the objections raised.

In illustration let us take a lesson on the invention of an ink-bottle, as actually conducted in class by the writer. It should be remembered that the many particulars given were suggested at random by members of the class, taken down upon the black-board, and subsequently arranged in order, the arrangement often suggesting other particulars evidently required for the completion of the scheme.

Notes of Object Lesson on an Ink-Bottle.

Practice in Invention.

I. Parts required—For simplicity these should be as few as possible.

- *a.* Receptacle for ink, so shaped as to stand.
- *b.* Opening to receptacle.
- *c.* Cover.
- *d.* Place for pen.

II. Material chosen.

Necessary and desirable properties of material.

- *a.* Non-absorbent of ink.
- *b.* Chemically indifferent to ink.
- *c.* Rigid enough to maintain its shape.
- *d.* Strong enough to resist hard usage.
- *e.* Hard enough, not to be easily scratched.
- *f.* It should be inexpensive.

* Lack of space compels us to omit the notes on the two former subjects as given in the paper when read. We give those on the ink bottle only.

g. And easily wrought.
h. And light.
i. The part which the pen-point strikes in dipping should be soft
k. Transparency would be advantageous.

The following substances were proposed :—

1st. For the Receptacle.

a. Wood was rejected because it is absorbent.
b. Soapstone because it is too easily scratched.
c. Lead, iron, copper, because not chemically indifferent to ink.
d. Glazed earthenware, because the glaze cracks, and then the ink is absorbed.
e. Gold and silver, because too expensive.
f. Porcelain and glass were accepted as fulfilling, when thick enough, all necessary conditions, but glass was preferred because of its transparency.
g. A pad of vulcanized rubber was suggested for the pen-point to strike on in dipping.

2nd. For the Cover, which should also be the place for the pen, any metal was deemed suitable.

III. Qualities.

In choosing the material all essential qualities except size and shape were already determined.

1st. Size.—Essential :

a. That the pen should dip into the ink neither more nor less than ½ an inch ;
b. That the total dip into the bottle should not exceed one inch and a half ; and
c. That the bottle should hold from one to two ounces of ink.

2nd. Shape.—This must be such that

a. It shall not be readily upset ; hence the centre of gravity must be low, and there must be no projecting corners to catch in anything.
b. If overthrown the ink shall not spill ; this implies an inverted tube as in a common form of pocket ink-bottle.
c. The pen shall dip into a constant depth of one-half inch of ink ; this implies the principle of the bird fountain, as in a common form of mucilage bottle.
d. Dust shall be excluded ; for this a cover, as already suggested, will provide.
e. The ink shall not be exposed to evaporation ; this implies a very small surface of ink exposed to the air.
f. The pen shall not dip into sediment ; this implies a dome shape to the pad on which the pen strikes, so that sediment shall not rest on it.
g. It may be easily cleaned ; hence it must have a smooth contour without angles both inside and out, and it must afford access to the interior.

It would be interesting, but for lack of time, to follow in detail the multitude of devices absurd, contradictory, inadequate, ingenious, suggested by the class in attempting to meet the various conditions, hard to reconcile, laid down in the foregoing scheme—a scheme proposed by the class itself in considering what was desirable in an ink-bottle, and

in recollecting the various mishaps that its members had experienced in the use of ink. These suggestions were considered, criticised, adopted provisionally, laid aside or finally adopted by the class, and issued in the adoption of a bottle of which a description follows. Externally, it was a smooth hemisphere of colorless glass, of two and a half inches radius. Two round openings communicated with the interior; the first one-fourth of an inch in diameter, placed at the summit of the hemisphere, was for the dipping of the pen into the ink, and was loosely closed for exclusion of dust by a light, metallic, hinged cover; the second, for filling the bottle, was three-eighths of an inch in diameter, was placed about three-fourths of an inch from the former opening, and was covered with a screw cap, recessed into the glass so as not to interfere with the smooth hemispherical contour of the bottle. Interiorly, the bottle presented a pear-shaped receptacle for the ink, with the broad part of the pear, much exaggerated in breadth, uppermost, so that the eye of the pear would coincide with the opening at the apex of the hemisphere. From this opening depended into the receptacle a tube of glass, one-fourth of an inch in diameter, open above and below, sealed above all around to the opening, and reaching below to within three-quarters of an inch of the bottom of the ink receptacle. Beneath the tube, and resting on the bottom, was a hemispherical pad of rubber three-eighths of an inch in diameter. Finally, on the top of the metal cover was a groove, in which the pen might be laid when the cover was closed. A little consideration will show that we had secured a bottle that could scarcely be upset, that would not, if upset while the screw cap was on, spill the ink it contained, that secured the ink from evaporation and dust, that would not allow the pen to dip too deeply nor into sediment, that saved the pen-point from injury, that, by loosening the screw-cap, could be filled, and that, by removing the cap, could be easily and thoroughly cleaned. All this of cheap material and without complication of parts.

I must not attempt to show you how fitly the Object Lesson introduces every branch of natural science, geography, natural philosophy, chemistry, botany, zoology. It is indeed the scientific method applied to the beginnings of knowledge. Nor need this consideration deter any teacher from attempting it, for the scientific method is nothing else than common sense applied to the acquisition of knowledge. The teacher who is eminently successful in conducting a series of Object Lessons must have eminent gifts. But these gifts are in a degree possessed by us all, and will be eminently possessed by whichever of us will apply himself to their cultivation with eminent labour and self-denial.

In conclusion, permit me briefly to advert to an objection sometimes thoughtlessly urged against Object Lessons, to the effect that useless smatterings of science are taught. *Non multa sed multum*, says the objector. Of course when a man hurls a Latin quotation at us we ought to subside; but what we ought and what we do are sometimes diverse from each other. In this case I shall try to stand up against the quotation. No fact clearly apprehended, whether a fact of natural philosophy, or chemistry, or botany, or psychology, is a smattering of science; nor do twenty nor fifty such facts constitute a smattering. They are the true beginnings of science. He is a smatterer who, without himself tracing the inductions, accepts from any source the generalizations of science, not he who is engaged in patiently collecting and considering the facts that are the foundation of all generalizations. For the life of me I cannot see that the quality of a generalization taken

on trust much affects the folly—and shall I say superstition—of accepting generalizations on authority. He who believes that the *radii vectores* of the planets sweep out equal areas in equal times, because he has read that Newton says so, is much on a par with the man who believes that cucumber seed should be sown on St. Laurence's day, because he has been told so, and is as an astronomer incalculably below the intelligent hind, who says the new moon returns every twenty-eight days, for I have counted, and I know; even though the latter has discovered an approximation to truth only, and the former may have learned his truth in the slightly modified form which would make it exact. And as for the Latin quotation, appalling enough if met in a lonely lane on a dark night, it will scarcely affright us here in broad daylight. In respect of science, no man can know *multum* who does not know *multa*. There is no eminent scientist who is not conversant with many sciences as well as great in one. A man may be a Latinist, and nothing else, a Grecian, and nothing else, but he cannot be an astronomer, a biologist, a psychologist, and nothing else. Surely those who speak of *multum non multa* as the guiding principle of a boy's education forget what is the obvious method of nature. She assails our ears at once with multitudinous voices. She unrolls before our eyes her brilliant scroll, written over with characters a thousand fold more diverse than the logographs of Chinese literature, a thousand fold more mysterious than the hieroglyphics of Memphis and Thebes, a thousand fold more gorgeously illuminated than any mediæval psalter. On all our senses, and on all at once, myriad-formed external nature pours her odors, her sights, her sounds. Nor is this all. As when one rolls a rock into some dim abyss we hear uprising the clash and rumble and roar of the far-descending stone, so when nature drops a sensation into the depths of our being, instantly uprise the murmuring voices of reason, of judgment, of imagination, sounding ever nearer and ever louder the mysterious burden of the universe. Then, too, awakes all the strange inner world of emotion and of will that never, never can be lulled to sleep again. Surely nature does not say *non multa*. Again, the knowledge of many things, not much of one thing, constitutes the true preparation for life. If you can, teach a boy one thing only, and turn him adrift in the world. No matter how thoroughly he knows that one thing he will be found altogether unfit to play any useful or successful part amid the activities of this many-sided life. The maxim quoted is the result of an imperfect conception of life. While preparation for duty is general, many things must be taught. When the general preparation is complete, and a definite course of life is chosen, one line of study must be steadily and engrossingly pursued. Permit me to amend the maxim, and say *post multa multum*. And permit me, as my last word, to say, let him who aims at an education that shall be eminently practical not neglect to make diligent and wise use of Object Lessons, as of a most valuable and efficient means of intellectual culture.

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